

What is claimed is:

1. An image sensor with optical guard rings,
comprising:

a substrate having a plurality of sensor areas;

5 a stacked inter-metal dielectric layer disposed on the
substrate;

air gaps disposed in the stacked inter-metal dielectric
layer between the sensor areas; and

10 a light transmitting insulating layer disposed on the
stacked inter-metal dielectric layer without
filling the air gaps.

2. The image sensor with optical guard rings of claim
1, wherein the light transmitting insulating layer is a
PECVD oxide layer.

15 3. The image sensor with optical guard rings of claim
1, further comprising an interlayer dielectric layer (ILD
layer) disposed between the stacked inter-metal dielectric
layer and the substrate.

20 4. The image sensor with optical guard rings of claim
1, further comprising another inter-metal dielectric layer
disposed on the light transmitting insulating layer.

5. A device comprising an image sensor with optical
guard rings of claim 1 embedded therein.

25 6. The device of claim 5, wherein the device is a
cellular phone.

7. The device of claim 5, wherein the device is a digital camera.

8. The device of claim 5, wherein the device is a toy.

5 9. An image sensor with optical guard rings, comprising:

a substrate having a plurality of sensor areas;

a stacked inter-metal dielectric layer disposed on the substrate;

10 optical guard rings with an index of refraction, $n=1$, disposed in the stacked inter-metal dielectric layer between the sensor areas; and

a light transmitting insulating layer disposed on the stacked inter-metal dielectric layer and the optical guard rings.

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10. The image sensor with optical guard rings of claim 9, wherein the optical guard rings are air gaps.

11. The image sensor with optical guard rings of claim 9, wherein the light transmitting insulating layer is a PECVD oxide layer.

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12. The image sensor with optical guard rings of claim 9, further comprising an interlayer dielectric layer (ILD layer) disposed between the stacked inter-metal dielectric layer and the substrate.

13. The image sensor with optical guard rings of claim 9, further comprising another inter-metal dielectric layer disposed on the light transmitting insulating layer.

14. A device comprising an image sensor with optical
5 guard rings of claim 9 embedded therein.

15. The device of claim 14, wherein the device is a cellular phone.

16. The device of claim 14, wherein the device is a digital camera.

10 17. The device of claim 14, wherein the device is a toy.

18. A method for forming an image sensor with optical guard rings, comprising:

15 providing a plurality of sensor areas in a substrate;
forming an interlayer dielectric layer on the substrate
and the sensor areas;
forming a stacked inter-metal dielectric layer on the
interlayer dielectric layer;
forming a plurality of gaps in the inter-metal
20 dielectric layer around each pixel; and
forming a light transmitting insulating layer on the
stacked inter-metal dielectric layer without
filling the gaps.

19. The method for forming an image sensor with
25 optical guard rings of claim 18, wherein the light

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transmitting insulating layer is formed by deposition with PECVD and planarization with CMP.

20. The method for forming an image sensor with optical guard rings of claim 18, further comprising forming
5 another inter-metal dielectric layer on the light transmitting insulating layer.